

- ☐ The Commissioner is hereby authorized to charge the appropriate fee of \$.00 pursuant to 37 C.F.R. §1.17(c) and 37 C.F.R. §1.136(a) and any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-0502.
- ☒ The Commissioner is hereby also authorized to charge any fees which may be required during the pendency of this application, including any patent application processing fees under 37 C.F.R. 1.17, and any filing fees under 37 C.F.R. 1.16, including presentation of extra claims, or credit any overpayment to Deposit Account No: 06-0502.

REMARKS

The last Office Action of February 19, 2002, has been carefully considered. Reconsideration of the instant application in view of the following remarks is respectfully requested.

Claims 1 to 8, 10 and 11 are pending in the application.

Claims 1-3 stand rejected under 35 U.S.C. §103(a) as being unpatentable over newly cited Melamed (U.S. Pat. No. 3,975,694) in view of Fulbert (U.S. Pat. No. 6,014,393).

Claims 4-5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Melamed (U.S. Pat. No. 3,975,694) in view of Esterowitz (U.S. Pat. No. 5,086,432).

Claim 6 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Melamed and Fulbert, and further in view of Kataoka (U.S. Pat. No. 6,129,721).

Claims 7-8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Melamed and Esterowitz, and further in view of Kataoka (U.S. Pat. No. 6,129,721).

Claim 10 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Melamed and Fulbert, and further in view of Richmond (U.S. Pat. No. 5,699,376).

Claim 11 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Melamed and Esterowitz, and further in view of Richmond (U.S. Pat. No. 5,699,376).

REJECTION UNDER 35 U.S.C. §103(a)

The rejection of claims 1-3 under 35 U.S.C. §103(a) as being unpatentable over Melamed in view of Fulbert, and of claims 6 and 10 further in view of Kataoka and Richmond, respectively, is hereby traversed and reconsideration thereof is respectfully requested.

Claim 1 is directed to a stable resonator for solid-state lasers, which exhibit a thermally induced lensing effect. The stable resonator includes a laser rod, a rear mirror and a semi-reflecting output mirror. The rear mirror is convex, the end of the laser rod facing the rear mirror is also convex, and the output

mirror is arranged in close proximity to the other end of the laser rod. The output mirror is semi-reflecting. Claims 2-3, 6, and 10 depend from claim 1.

The Melamed reference discloses a self Q-switching NdUO₂ -glass laser which includes a diffusing medium, for example, a curvilinear resonator. (FIG. 1) Melamed shows an external convex resonator 12, but does not disclose that either of the end faces of the laser rod is convex. More particularly, Melamed does not disclose or suggest that the end face of the laser rod facing the convex mirror is convex.

Fulbert discloses an end-pumped microlaser cavity consisting of a stack of multilayers. The active laser medium is constituted by a material of limited thickness (between 150 and 1000 μm) and of small size (a few mm^2) on which are directly deposited dielectric cavity mirrors. The examiner points to FIG. 4 which shows a highly doped, active laser medium (6) with a cavity limited by input (26) and output (28) mirrors of the active laser medium. A pumping beam (36) is directed onto the input mirror (26). The concave mirror (26) reduces the size of the laser beam in the electro-optical medium (30).

For the device of Fulbert to operate as designed, the mirror (26) would have to be coated to be essentially transparent to the pumping beam (36) and have an essentially 100% reflectivity at the cavity lasing wavelength. In other words, no cavity laser light passes through Fulbert's concave mirror (26).

The Examiner asserts that it would be obvious to combine the curvilinear resonator of Melamed's laser with Fulbert's concave mirror design to arrive at the present invention.

Applicant disagrees. Fulbert's concave mirror 26 is highly reflective at the lasing wavelength, whereas the rod end 11 of the present invention is transparent to the lasing wavelength, since the cavity is formed between the semi-reflecting output mirror and the convex rear mirror.

If Fulbert's microlaser cavity 6 depicted in Fig. 4 were to be substituted for Melamed's laser rod 10, all the laser light generated in the laser rod would be reflected at the mirror (26) of the microlaser facing the convex mirror 12 rather than at the rear mirror itself. Accordingly, the convex rear mirror 12 would not serve the intended function.

There is no teaching in the Melamed and Fulbert references (both of which are basically directed to Q-switched devices) that it would be advantageous to design an extremely asymmetric resonator in order to reduce the thermal lensing effect in solid state lasers over a greater range of pump power. Applicants states on page 6, lines 3 to 7, of the instant specification that "[the] special arrangement of the components in conjunction with a suitable arrangement of the resonator length and the respective radii of curvature provides a resonator which produces a small focus with a short overall length, wherein the focus is almost independent of the frequency and the pump power, respectively." As a result, not only does a combination of the Melamed and Fulbert references fail to provide a working device, as discussed above, but Melamed and Fulbert also do not provide a motivation to combine the a convex mirror with a convex shaped laser rod end. The Examiner's statement that "it would be obvious to make integral the output mirror with the rod" is misguided

because this is not what the present invention is about and what is recited in claim 1.

In summary, Melamed and Fulbert, taken either alone or in combination, do not disclose, teach or suggest the subject matter recited in the independent claim 1. Accordingly, Applicant respectfully requests that the rejection of claim 1 be withdrawn. Claims 2-3, 6, and 10 which depend from claim 1 should then also be patentable since neither Kataoka nor Richmond supply the element(s) missing from the Melamed and Fulbert references, namely that the rear mirror is convex and the end of the laser rod facing the rear mirror is also convex, as recited in claim 1.

The rejection of claims 4 and 5 under 35 U.S.C. §103(a) as being unpatentable over Melamed ('694) in view of Esterowitz (US 5,086,432), and of claims 7 and 8 further in view of Kataoka (US 6,129,721) and of claim 10 further in view of Richmond (US 5,699,376) is hereby traversed and reconsideration thereof is respectfully requested.

Claim 4 is directed to a stable resonator for solid-state lasers which exhibit a thermally induced lensing effect. The stable resonator includes a laser rod, a rear mirror and a semi-reflecting output mirror. The rear mirror is convex and the end of the laser rod facing the rear mirror is planar. The other end of the laser rod is convex, and the output mirror is formed by the other end of the laser rod, wherein this end is semi-reflecting. Claim 8 depends from claim 4.

Claim 5 is directed to a stable resonator for solid-state lasers wherein unlike claim 4, the output mirror is arranged in close proximity to the other end of

the laser rod instead of being formed by the other end of the laser rod. Claims 7 and 11 depend from claim 5.

Melamed discloses laser configurations with planar and convex resonator; a pair of convex resonators; a pair of concave resonators; and a convex and a concave resonator. The end faces of the laser rod are flat. (Figs. 1-4). The curvilinear resonators are provided to increase the effective pump volume and prevent filamentation which can lead to self-Q-switching.

Esterowitz discloses a laser resonator with a convex output face and a planar rear mirror. There is no suggestion in Esterowitz that the front end surface 19 of the crystal 15 can be curved. Since the laser rod 15 is a refractive optical element, the theory of lens design and design of optical systems in general convincingly affirms that a curved lens surface cannot simply be replaced by a planar surface and vice versa without a strong motivation to do so. Neither Esterowitz nor Melamed suggest any other design what is shown, and neither suggests that optical parameters (such as the radius of curvature of surfaces) could be changed arbitrarily without degrading the operation of such system or even making such system inoperable.

Applicant explicitly states the advantages of his design on page 13, lines 7-9, and 11-14 of the instant specification:

"It should be noted that the pulse energy is also almost independent of the history of the pump power. Accordingly, both the focus diameter and the energy density remain constant, which is of paramount interest for the user.

The preferred field of application of this invention are Nd:YAG welding lasers with a resonator length of less than 500 mm and a maximum average pump power of up to 2 kW (this corresponds to approximately 60 W average laser power)."

For the reasons set forth above, it is applicant's contention that neither Melamed nor Esterowitz, or Richmond or Kataoka, nor any combination thereof teaches or suggests the features of claims 4 and 5. As for the rejection of the retained dependent claims 7, 8, and 11, these claims depend on claims 4 and 5, respectively, and share their presumably allowable features, and therefore it is respectfully submitted that these claims should also be allowed.

Withdrawal of all rejections under 35 U.S.C. §103(a) and allowance of claims 1-8, 10 and 11 are thus respectfully requested.

CONCLUSION

Applicant believes that when the Examiner reconsiders the claims in the light of the above comments, he will agree that the invention is in no way properly met or anticipated or even suggested by any of the references however they are considered.

In view of the above presented remarks, it is respectfully submitted that all claims on file should be considered patentably differentiated over the art and should be allowed.

Reconsideration and allowance of the present application are respectfully requested.

Should the Examiner consider necessary or desirable any formal changes anywhere in the specification, claims and/or drawing, then it is respectfully requested that such changes be made by Examiner's Amendment, if the Examiner feels this would facilitate passage of the case to issuance. If the Examiner feels that it might be helpful in advancing this case by calling the undersigned, applicant would greatly appreciate such a telephone interview.

Respectfully submitted,

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